REMARKS

The present application was filed on April 13, 2001 with claims 1-40. Claims 1 through 40 are presently pending in the above-identified patent application.

In the Office Action, the Examiner required restriction of the claims under 35 U.S.C. §121. The drawings were objected to as failing to comply with 37 CFR 1.84(p)(5) because they include reference signs not mentioned in the description and because of handwriting in FIG. 14. The Abstract was objected to because of punctuation in line 2. The Examiner objected to claims 8 and 15 under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. The Examiner rejected claims 8, 10, 11, 15, 17, and 18 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner rejected claims 1-8, 10-15, 17, and 18 under 35 U.S.C. §102(e) as being anticipated by Mui (United States Patent Number 6, 690,739) and rejected claims 37 and 38 under 35 U.S.C. §103(a) as being unpatentable over Mui. The Examiner indicated that claims 9 and 16 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

The present invention is directed to a method and apparatus for the implementation of reduced state sequence estimation that uses precomputation (look-ahead) to increase throughput, with only a linear increase in hardware complexity with respect to the look-ahead depth. The present invention limits the increase in hardware complexity by taking advantage of past decisions (or survivor symbols). The critical path of a conventional RSSE implementation is broken up into at least two smaller critical paths using pipeline registers. Various reduced state sequence estimation implementations are disclosed that employ one-step or multiple-step look-ahead techniques to process a signal received from a dispersive channel having a channel memory.

Election of Claims

The Examiner required restriction under 35 U.S.C. 121 to the invention of Group I, claims 1-18, 37, and 38, drawn to a method for processing a signal by precomputing intersymbol interference estimates, classified in class 714, subclass 796;

Group II, claims 19-30 and 39, drawn to a method for processing a signal by precomputing partial intersymbol interference estimates and selecting precomputed partial intersymbol interference estimates for postcursor taps other than the first postcursor tap, classified in class 714, subclass 796; or Group III, claims 31-36 and 40, drawn to a method for processing a signal by precomputing partial intersymbol interference estimates and selecting precomputed partial intersymbol interference estimates for postcursor taps, classified in class 714, subclass 796.

Applicants hereby affirm the election of the claims of Group I with traverse and withdraw the claims of Group II and Group III, without prejudice.

Drawings

The drawings were objected to as failing to comply with 37 CFR 1.84(p)(5) because they include reference signs not mentioned in the description and because of handwriting in FIG. 14.

The drawings have been amended to delete the reference signs that were not mentioned in the description. The formal drawings are also resubmitted herewith with a FIG. 14 that does not contain handwritten text. Applicants respectfully request that the objections to the drawings be withdrawn.

Formal Objections

The Abstract was objected to because of punctuation in line 2.

The Abstract has been amended to correct the punctuation of line 2 and Applicants respectfully request that the objection to the Abstract be withdrawn.

Claims 8 and 15 were objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. In particular, the Examiner asserts that claim 8 fails to further limit claim 1 since it is not clear that the method actually uses any pipelining.

Applicants note that, whether or not the method of claim 8 actually uses pipelining, claims 8 and 15 require that the methods *must allow* for pipelining to be used before or after each of said selections. Claims 1 and 12 are *not required* to allow such pipelining. Thus, claims 8 and 15 properly further limit their parent claims.

Section 112 Rejections

Claims 8, 10, 11, 15, 17, and 18 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claim 8, the Examiner asserts that claims 8 and 15 are indefinite since they fail to further limit claim 1 (since it is not clear that the method actually uses any pipelining).

Applicants note that, whether or not the method of claim 8 actually uses pipelining, claims 8 and 15 require that the methods *must allow* for pipelining to be used before or after each of said selections. Claims 1 and 12 are *not required* to allow such pipelining. Thus, claims 8 and 15 further limit their parent claims and are definite.

Regarding claim 10, the Examiner asserts that the language "at least two-dimensional branch metrics" is incomprehensible since it is not clear whether the cited language refers to – at least one two-dimensional branch metric – or -- at least two multi-dimensional branch metrics --.

Applicants note that the hyphen in the cited language means that the number two refers to the number of dimensions, not the number of branch metrics. As the Examiner notes, and as is apparent to a person of ordinary skill in the art, no hyphen is used after a number to indicate a quantity of the entity (branch metrics) and a hyphen after a number is used to indicate that the number refers to the number of dimensions. Thus, the Examiner used a hyphen in the term multi-dimensional to refer to an entity with a plurality of dimensions. Similarly, terms such as "three-dimensional" are used to describe entities with three dimensions. Thus, Applicants believe that claims 10, 11, 17, and 18 are definite and respectfully request that the section 112 rejections be withdrawn.

Independent Claims 1, 12, 37 and 38

Independent claims 1 and 12 were rejected under 35 U.S.C. §102(e) as being anticipated by Mui and claims 37 and 38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mui.

Regarding claim 1, the Examiner asserts that Mui teaches precomputing branch metrics.

Applicants note that Mui does not teach to *precompute branch metrics, i.e., does not comput branch metrics ahead of time* for *future* decisions. Mui also does

not teach to select a branch metric from a plurality of *precomputed branch metrics* based on a second past decision from a corresponding state. The value q(x,y) in Mui is a template and not a branch metric and, in any case, there is no selection based on a decision from a corresponding state. Independent claims 1, 12, 37, and 38 require precomputing branch metrics based on said precomputed intersymbol interference estimates or computing a branch metric based on said selected precomputed intersymbol interference estimates.

In addition, Mui's invention does not use a "reduced-state sequence estimation technique." Mui describes reduced-state sequence estimation techniques (note: "delayed decision feedback sequence estimation" is a "reduced-state sequence estimation technique") as prior art in the Background Section (col. 7, lines 22-58; col. 9, lines 1-7; col. 11, lines 27-55), and describes the invention as being different from reduced-state sequence estimation. Also, Applicants could find no indication that Mui uses features of the well known "reduced-state sequence estimation technique," where separate intersymbol interference estimates are computed for each trellis state based on survivor symbols for this state.

Applicants also note that Mui (col. 25, lines 35-60) does not teach to *precompute* speculative intersymbol interference estimates for a first postcursor tap of said channel impulse response based on each possible value for a data symbol. Mui does not define q_{Lx+1} as being a partial intersymbol interference estimate for a first postcursor tap. In fact, equation 43 in Mui demonstrates that it is apparent that the index for the first postcursor tap is 1 and not Lx+1. Also, q_{Lx+2}, q_{Lx+3}, etc. are not partial interference estimates of subsequent postcursor taps, as the indices for those subsequent postcursor taps are 2, 3, etc. and not Lx+2, Lx+3, etc.

Thus, Mui does not disclose or suggest precomputing branch metrics based on said precomputed intersymbol interference estimates or computing a branch metric based on said selected precomputed intersymbol interference estimates, as required by independent claims 1, 12, 37, and 38.

Dependent Claims 2-11 and 13-18

Dependent claims 2-8, 10, 11, 13-15, 17, and 18 were rejected under 35 U.S.C. §102(e) as being anticipated by Mui.

Claims 2-11 and claims 13-18 are dependent on claims 1 and 12, respectively, and are therefore patentably distinguished over Mui because of their dependency from independent claims 1 and 12 for the reasons set forth above, as well as other elements these claims add in combination to their base claim. The Examiner has already indicated that claims 9 and 16 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

In addition, with regard to claim 2, Mui (col. 6, lines 20-45) describes the output of a prior art decision-feedback equalizer, but not the computation of the templates q(x,y) that are described in col. 25, lines 35-60. Templates q(x,y) are not equal to partial intersymbol interference estimates. Also, the output of a prior art decision-feedback equalizer is not equal to partial intersymbol interference estimates. Thus, Mui does not disclose or suggest wherein said partial intersymbol interference estimates equal a channel coefficient multiplied by a data symbol value, as required by claim 2.

Regarding claim 3, Mui (FIG. 17) does not teach that (x,y) is a survivor symbol, and Mui does not teach that (x,y) is a decision from a corresponding state. There is no basis for this interpretation in the specification and FIG. 17. "Survivor symbol" is a well known term in the art that refers to the symbols retained for each surviving path in the Viterbi algorithm.

Regarding claim 4, Mui (col. 33, lines 65-57) does not teach to select one branch metric among precomputed ones based on an add-compare select decision. Also, the Viterbi algorithm does not select one branch metric among precomputed ones based on add-compare-select decisions.

Regarding claim 7, Mui (col. 33, lines 65-67) just references a standard Viterbi algorithm; "reduced-state sequence estimation", "decision-feedback sequence estimation", "delayed decision-feedback sequence estimation" and "parallel decision feedback decoding" are distinctly different from the Viterbi algorithm and from Mui's disclosed technique.

All of the pending claims, i.e., claims 1-18, 37, and 38, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

The Examiner's attention to this matter is appreciated.

Respectfully submitted,

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Annotated Sheet Showing Changes

FIG. 5

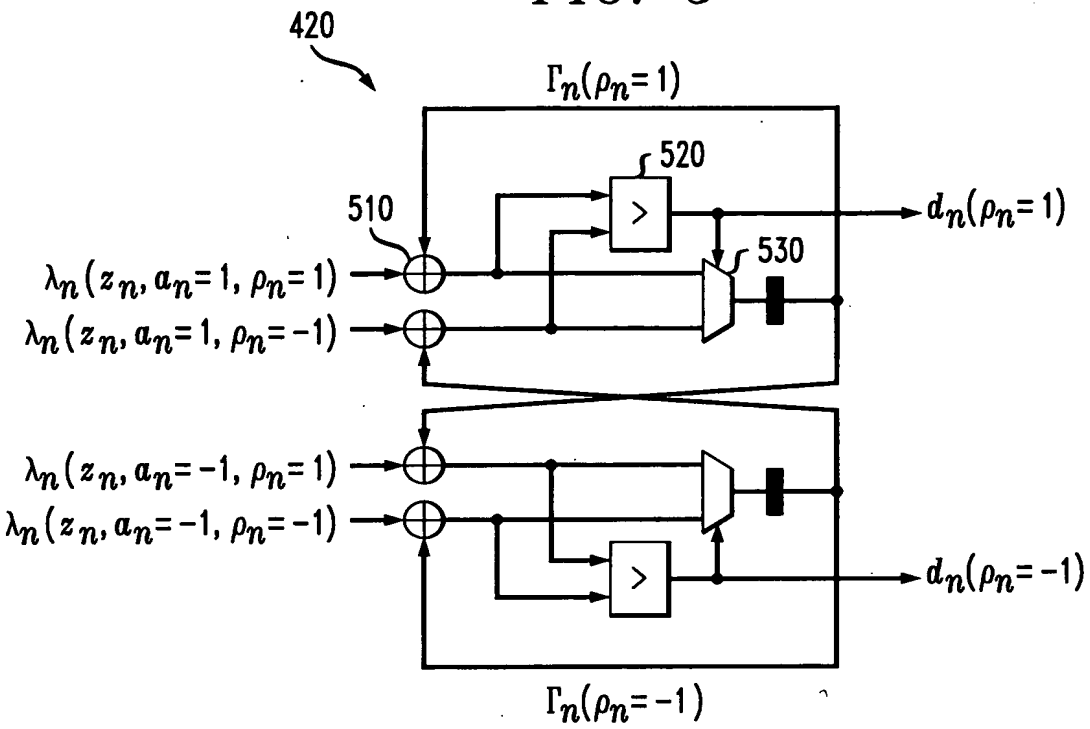

FIG. 6

COMPLEXITY AND CRITICAL PATH ANALYSIS TABLE -- 600

	620 MLSE	630 RSSE
COMPLEXITY		
NO. OF STATES:	2^L	2^K
NO. OF BMs	2^{L+1}	2^{K+1}
ADDs IN DFU:	——	$S \times L$
CRITICAL PATH	2 ADDs 2-to-1 MUX	$L-K+3$ ADDs 2-to-1 MUX LUT SHIFT

Annotated Sheet Showing Changes

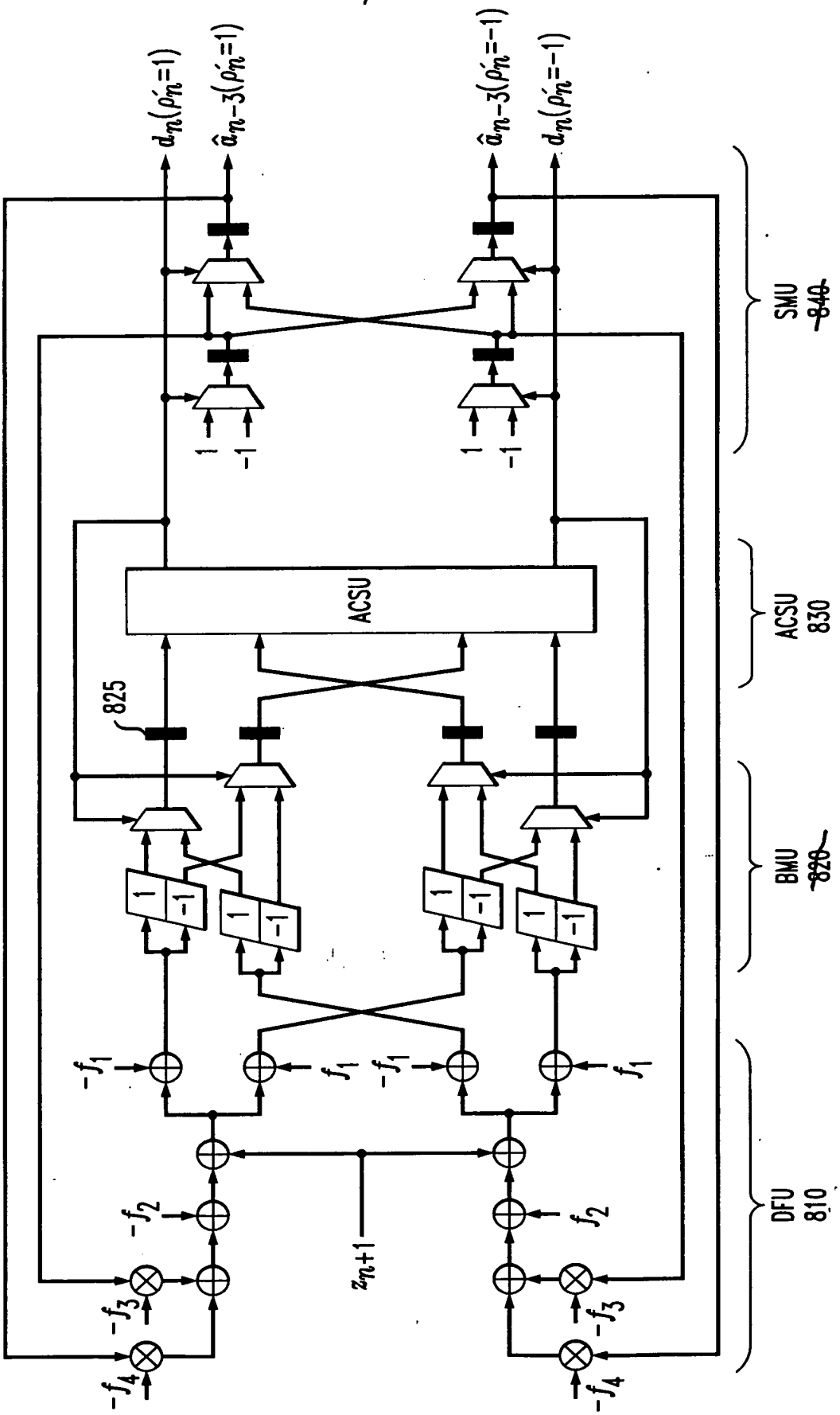

FIG. 8

Annotated Sheet Showing Changes

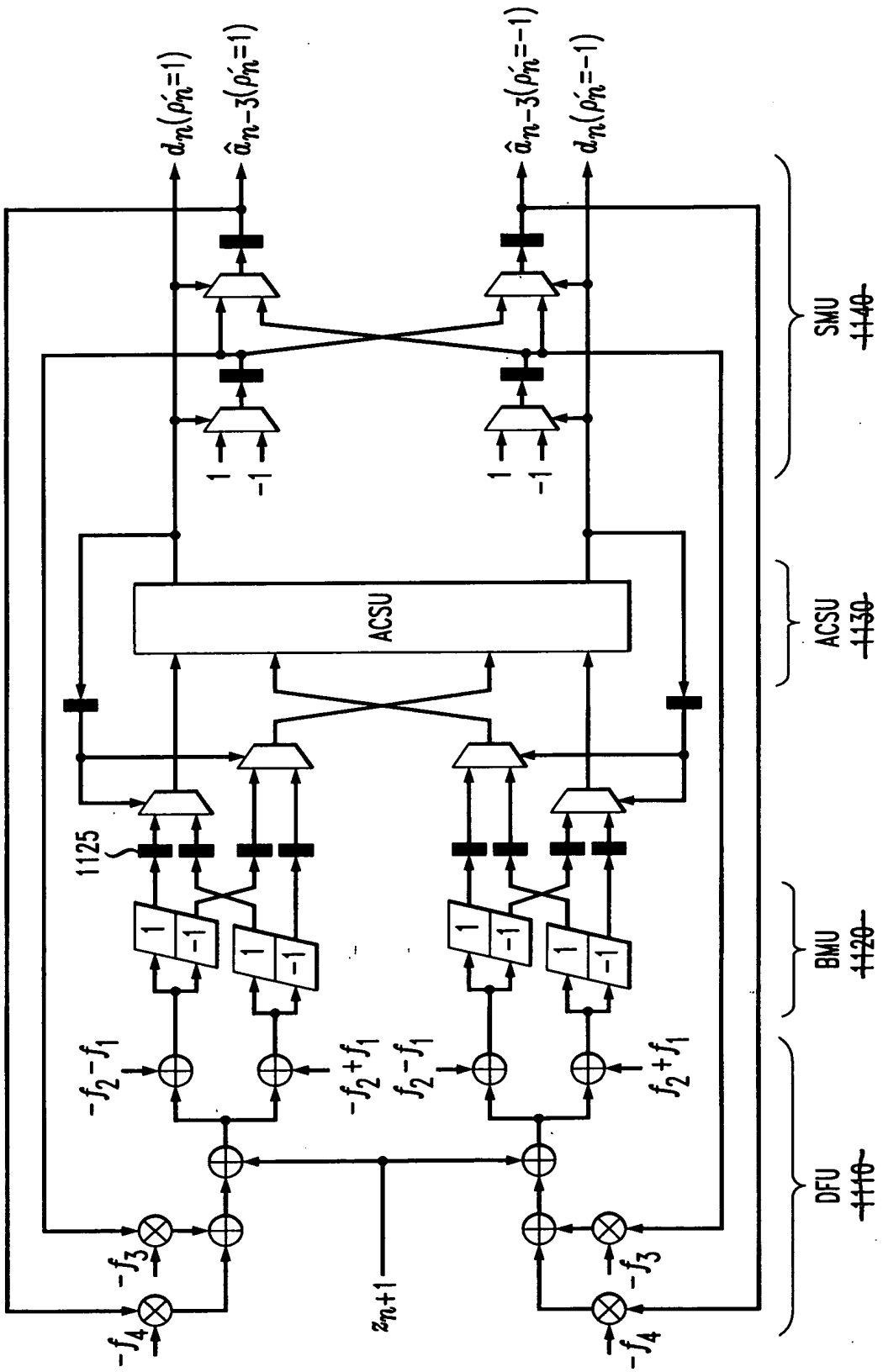

FIG. 11

Annotated Sheet Showing Changes

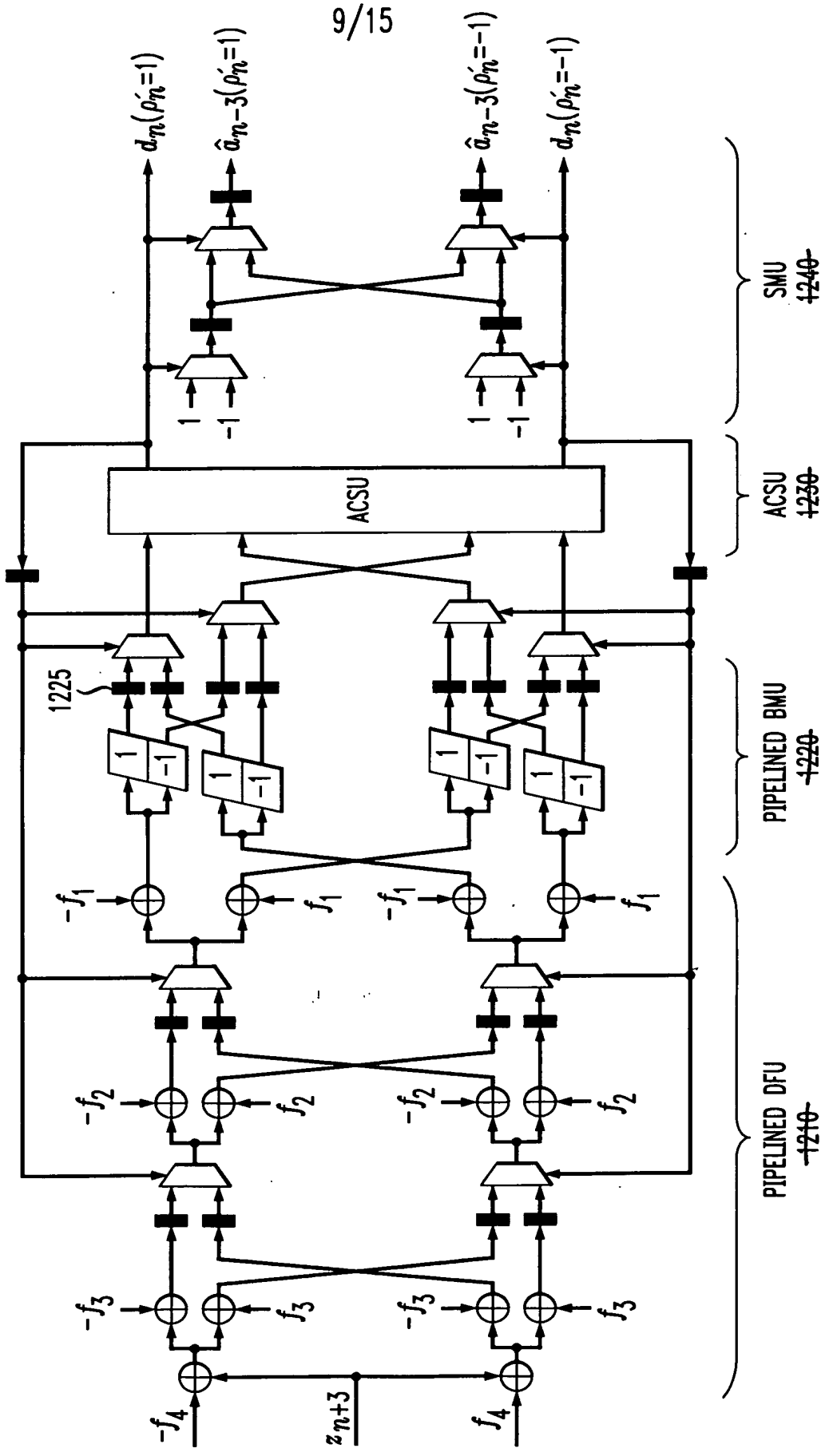

FIG. 12